the first shaft, a collimated light source mounted on the sensor head for transmitting a beam of energy in a direction that is substantially parallel to the first shaft, and a photosensitive sensor mounted on the sensor head for sensing light and generating a position signal corresponding to a position of a light beam impinging upon the photosensitive sensor, an angular position sensing apparatus comprising:

at least one accelerometer for generating a signal corresponding to the angular orientation of the sensor head with respect to the first shaft, and

a microprocessor for processing the signal generated by the at least one accelerometer, operable to provide an output corresponding to the angular position of the sensor head relative to the first shaft.

REMARKS

Claims 1-22 are in the case and stand rejected. Claims 1 and 11 are hereby amended. Claim 1 is amended to remove an unnecessary limitation, and claim 11 is amended to correct a formal non-substantive matter. No new matter has been added by the amendments. Claims 1-3, 6, and 10-22 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,727,900 to Sandstrom (the '900 patent), in view of U.S. Patent No. 5,213,184 to Legouis et al. (the '184 patent), and U.S. Patent No. 4,021,774 to Asmundsson et al. (the '774 patent).

Claim 4 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over the '900 patent in view of U.S. Patent No. 4,990,840 to Migda (the '840 patent).

Claim 5 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of the '900 patent as applied to claim 4, further in view of U.S. Patent No. 5,845,236 to Jolly et al. (the '236 patent).

Claim 7 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of the '900 patent as applied to claim 6, further in view of U.S. Patent No. 6,304,190 to Blasing (the '190 patent).

Claim 8 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of the '900 patent as applied to claim 1, further in view of the '184 patent.

Claim 9 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of the '900 patent as applied to claim 1, further in view of U.S. Patent No. 5,890,870 to Berger et al. (the '870 patent).

These rejections are respectfully traversed. Reconsideration and allowance of the claims are hereby respectfully requested.

Rejections Based on the 35 U.S.C. § 103(a)

Claims 1-3, 6, and 10-22 stand rejected under 35 U.S.C. § 103(a) as being obvious over the '900 patent, in view of the '184 patent and the '774 patent. Applicants respectfully traverse the rejections.

Applicants assert the references taken alone or in combination do not teach or suggest an angular position sensing apparatus as claimed in independent claim 1. Claim 1 is directed to an angular position sensing apparatus using accelerometers to determine angular position. More particularly, claim 1 requires two dual-axis accelerometers which produce signals based on the rotational orientation of a rotatable body. The apparatus includes a microprocessor to process the accelerometer signals and to determine an angular position of the rotatable body relative to a point in space based upon the processed accelerometer signals.

The '900 patent does not teach or suggest an apparatus using accelerometer signals to determine an angular position of a rotatable body. The '900 patent teaches a control system for controlling a compacting machine with a measurement of the characteristics of a ground material. The control system uses first and second accelerometer measurements when determining ground material characteristic properties (col. 3, lines 54-67; col. 4, lines 1-13), such as shear modulus and a plastic parameter of the ground material. The accelerometers are not used to determine the angular position of a rotating element. Referring to Fig. 2, it is clear that the accelerometers do not rotate with the drum 7, since the accelerometers are fixed to a bearing bracing 9. Even if the accelerometer do rotate with the drum, they are not used to determine angular position.

The '900 patent uses a separate rotation sensor 11 for determining the angle of the eccentric weight used in the compaction. The rotation sensor 11 provides a signal

indicating the amplitude and phase position of the eccentric weight in relation to the first and second acceleration signals. The rotation sensor 11 provides an electric pulse every time the eccentric weight passes (col. 5, lines 52-55). The eccentric weight angle is then estimated by calculating the rotational speed using two consecutive pulses and the time since the last pulse. Thus, the '900 patent does not teach the angular sensing apparatus as claimed in independent claim 1.

The '184 patent does not remedy the deficiencies of the '900 patent. The '184 patent also does not teach or suggest using accelerometer signals to determine an angular position of a rotatable body. The '184 patent does not even mention the determination of an angular position. The '184 patent describes a system for compensating for a vibrational force using four motor driven rotating weights having parallel rotation axes. Accelerometers produce vibration signals enabling a control device to calculate the proper rotational frequency and amplitude of the rotating weights to compensate for the measured vibration forces. The motors that drive the weights use angular encoders to compute speed set points (col. 6, lines 55-60). Thus, the '184 patent, taken alone or in combination with the '900 patent, does not provide the angular position sensing apparatus as claimed in independent claim 1.

The '774 patent also does not remedy the deficiencies of the '900 patent. The '774 patent does not teach an angular sensing apparatus for determining the angular position of a rotatable body by selecting a fifth signal dependent on first and third dual-axis accelerometer signals, or a sixth signal dependent on second and fourth dual-axis accelerometer signals, as claimed in independent claim 1 of the present application. At col. 2, lines 50-54, the '774 patent states that angle measurement is determined solely by counting the number of steps required to operate stepping motors to drive respective gimbals to null positions. The '774 patent describes a three gimbal system servo using two accelerometers (reference and inclination) and one magnotometer for measuring the characteristics of a borehole. The system uses the accelerometers to establish vertical and horizontal planes by finding the zero gravity position along two orthogonal axes.

More particularly, the system measures a reference angle by determining the movement required to move the reference accelerometer from a HOME position to a

position where the output of the accelerometer is zero. The reference angle is measured by counting the number of steps required for a step motor to go from the HOME position to a position where the reference accelerometer output is zero. The system measures an inclination angle by determining the movement required to move the inclination accelerometer from a HOME position to a position where the output of the inclination accelerometer is zero. The inclination angle is also measured by counting the number of steps required for a step motor to drive the inclination gimbal from the HOME position to a position where the inclination accelerometer output is zero.

Thus, since neither the '900 patent, the '184 patent, nor the '774 patent teach an angular position sensing apparatus as claimed in independent claim 1, the combination of the three cited patents do not teach the apparatus of claim 1. Thus, independent claim 1 patentably defines over the '900 patent in view of the '184 patent and further in view of the '774 patent. Reconsideration and allowance of claim 1 is respectfully requested.

Dependent claims 2, 3, 6, and 10 depend from independent claim 1, and contain additional important aspects of the angular position sensing apparatus. Therefore, dependent claims 2, 3, 6, and 10 patentably define over the '900 patent in view of the '184 patent and further in view of the '774 patent. Reconsideration and allowance of dependent claims 2, 3, 6, and 10 are respectfully requested.

Independent claim 11 is not obvious in view of the teachings of the '900 patent in view of the '184 patent and further in view of the '774 patent. Independent claim 11 is directed to an alignment system for aligning a centerline of a first shaft with a centerline of a second shaft. The shaft alignment system includes an angular position sensing apparatus having at least one accelerometer for generating a signal corresponding to the angular orientation of a sensor head with respect to the first shaft. A microprocessor processes the signal generated by the at least one accelerometer, and provides an output corresponding to the angular position of the sensor head relative to the first shaft.

The '900, '184, and '774 patents are described in detail above. None of these patents pertain to shaft alignment systems, and one having ordinary skill in the shaft alignment field would not look to the teachings of compacting, borehole, and other unrelated arts. Thus, these patents are non-analogous art and should not be applied to

claim 11 and dependent claims 12-17. However, even if these patents were in an analogous art, none of these patents, taken alone or in combination, teach a shaft alignment system having an angular position sensing apparatus including at least one accelerometer as claimed in independent claim 11. Thus, claim 11 patentably defines over the teachings of the '900 patent, in view of the '184 patent, and further in view of the '774 patent. Reconsideration and allowance of claim 11 are therefore requested.

Dependent claims 12-17 depend from independent claim 11, and contain additional important aspects of the shaft alignment system having an angular position sensing apparatus. Therefore, dependent claims 12-17 patentably define over the '900 patent in view of the '184 patent and further in view of the '774 patent. Reconsideration and allowance of dependent claims 12-17 are respectfully requested.

Applicants further assert that independent claim 18 is not obvious in view of the teachings of the '900 patent in view of the '184 patent and further in view of the '774 patent. Independent claim 18 is directed to an angular position sensing apparatus for sensing the angular position of the apparatus as it rotates about a rotation point. The apparatus includes first and second dual axis accelerometers which produce acceleration signals. The apparatus further includes a processor which receives the accelerometer signals, and produces a signal corresponding to the angular position of the apparatus based on the accelerometer signals.

The '900, '184, and '774 patents are described in detail above. None of these patents, taken alone or in combination, teach an angular position sensing apparatus as claimed in independent claim 18. Thus, claim 18 patentably defines over the teachings of the '900 patent, in view of the '184 patent, and further in view of the '774 patent. Reconsideration and allowance of claim 18 is therefore requested.

Dependent claims 19-22 depend from independent claim 18, and contain additional important aspects of the angular position sensing apparatus. Therefore, dependent claims 19-22 patentably define over the '900 patent in view of the '184 patent and further in view of the '774 patent. Reconsideration and allowance of dependent claims 19-22 are respectfully requested.

Rejection of Claim 4 Based on the Combination of '900 patent as Applied to Claim 1 and further in view of the '840 patent

Applicants assert that the '840 patent does not remedy the deficiencies of the combination of the '900 patent as applied to claim 1. The '840 patent describes a method and system for controlling a machine tool. The '840 patent describes using a spindle encoder to monitor the angular position of a piston about its axis. The '840 patent does not teach or suggest an apparatus using accelerometer signals to determine the angular position of a rotatable body as claimed in claim 1. Dependent claim 4 depends from claim 1 and requires a finite impulse response filter for further processing the accelerometer signals. Thus, claim 4 patentably defines over the combination of the '900 patent as applied to claim 1 and further in view of the '840 patent. Reconsideration and allowance of claim 4 are requested.

Rejection of Claim 5 Based on the Combination of '900 patent as Applied to Claim 4 and further in view of the '236 patent

The '236 patent does not remedy the deficiencies of the combination of the '900 patent as applied to claim 4. The '236 patent describes a hybrid active-passive noise and vibration control system for an aircraft. The '236 patent does not teach or suggest an apparatus using accelerometer signals to determine an angular position of a rotatable body. Since dependent claim 5 depends from claim 4 and contains additional important aspects of the angular position sensing apparatus as claimed in claim 4, claim 5 patentably defines over the combination of the '900 patent as applied to claim 4 and further in view of the '236 patent. Thus, reconsideration and allowance of claim 5 are requested.

Rejection of Claim 8 Based on the Combination of '900 patent as Applied to Claim 1 and further in view of the '184 patent

As described above, the '184 patent does not remedy the deficiencies of the '900 patent as applied to claim 1. Dependent claim 8 depends from claim 1 and contains additional important aspects of the angular position sensing apparatus. Thus, claim 8

patentably defines over the '900 patent as applied to claim 1 and further in view of the '184 patent. Reconsideration and allowance of claim 8 are requested.

Rejection of Claim 9 Based on the Combination of '900 patent as Applied to Claim 1 and further in view of the '870 patent

The '870 patent does not remedy the deficiencies of the combination of the '900 patent as applied to claim 1. The '870 patent describes an electronic ride control system for off-road vehicles. The '870 patent does not teach or suggest an angular position sensing apparatus using accelerometer signals to determine an angular position of a rotatable body. Dependent claim 9 depends from claim 1 and requires a noise spike filter for classifying a noise spike signal. Thus, claim 9 patentably defines over the combination of the '900 patent as applied to claim 1 and further in view of the '870 patent. Reconsideration and allowance of claim 9 are requested.

CONCLUSION

Having now fully and completely responded to the office action, applicants assert that the claims are all fully in condition for allowance. Thus, reconsideration and allowance of all claims are respectfully requested.

If the examiner identifies further issues that may be resolved by telephone, the examiner is invited to contact the undersigned at 1.865.546.4305.

In the event that this response is not timely filed, applicants hereby petition for an appropriate extension of time. The fee for this extension, along with any other fees that may be due with respect to this response, may be charged to our deposit account number 12-2355.

Respectfully submitted,

LUEDEKA, NEELY & GRAHAM, P.C.

By: _____

Andrew S. Neely, 28,979

7/3/02

P.O. Box 1871
Knoxville TN 37901
1.865.546.4305

* * *

I hereby certify that this correspondence is being deposited on the date below with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Assistant Commissioner for Patents, Washington DC 20231.

7/3/02
Date

Andrew S. Neely, 28,979

P:\MTL\53199.am1.doc

MARKED UP VERSION TO SHOW CHANGES

Claim 1. (Once Amended) An angular position sensing apparatus for mounting on a rotatable body having a center of rotation and for determining an angular position of the rotatable body relative to a point in space comprising:

a first dual-axis accelerometer having a first sensing axis for sensing a first acceleration component and a second sensing axis for sensing a second acceleration component, wherein the first and second sensing axes are in substantially perpendicular relation, the first dual-axis accelerometer operable to output a first signal proportional to the sensed first acceleration component and to output a second signal proportional to the sensed second acceleration component,

a second dual-axis accelerometer having a third sensing axis for sensing a third acceleration component and a fourth sensing axis for sensing a fourth acceleration component, wherein the third and fourth sensing axes are in substantially perpendicular relation, the second dual-axis accelerometer operable to output a third signal proportional to the sensed third acceleration component and to output a fourth signal proportional to the sensed fourth acceleration component, the first and second dual-axis accelerometers being mounted in spaced apart relation [on a printed circuit board] defining a plane of reference and for being mounted on the rotatable body spaced apart from the center of rotation, and

a microprocessor operable to determine the angular position of the body as the body rotates through a plurality of angular positions by selecting a fifth signal dependent on the first and third signals or a sixth signal dependent on the second and fourth signals and determining the angular position of the rotatable body therefrom.

Claim 11. (Once Amended) In an alignment system for aligning a centerline of a first shaft with a centerline of a second shaft, the shaft alignment system including an analyzer having memory, a mounting bracket having engagement surfaces for engaging the first shaft and securing the bracket to the first shaft, a sensor head having a facing surface and a rear surface in opposing relation disposed on the mounting bracket and extending in a substantially perpendicular orientation with respect to the centerline of the first shaft, a collimated light source mounted on the sensor head for transmitting a

beam of energy in a direction that is substantially parallel to the first shaft, and a photosensitive sensor mounted on the sensor head for sensing light and generating a position signal corresponding to a position of a light beam impinging upon the photosensitive sensor, an angular position sensing apparatus comprising:

at least one accelerometer for generating a signal corresponding to the angular orientation of the sensor head with respect to the first shaft, and

a microprocessor for processing the [angular position sensor] signal generated by the [angular position sensor] <u>at least one accelerometer</u>, operable to provide an output corresponding to the angular position of the sensor head relative to the first shaft.